STATE OF NORTH CAROLINA
# DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

November 15, 2006

Division of Water Quality
585 Waughtown Road
Winston-Salem, NC 27107

ATTENTION: Ms. Sue Homewood
NCDOT Coordinator

Subject: **Response to DWQ on Hold Letter** for the permit application for the new construction of the High Point East Beltway, US 311 from south of US 29/70 to US 220, in Guilford and Randolph Counties, TIP R-609IA, IB, and R-2606A, B, and C.

Reference: R-609IA, IB, R-2606A, B, and C, Permit Application, submitted February 28, 2006
DWQ On Hold Letter, DWQ# 06-0331, Dated April 24, 2006

Dear Ms. Homewood:

On April 24, 2006 the Division of Water Quality (DWQ) issued a hold letter for the above mentioned project and requested the North Carolina Department of Transportation (NCDOT) resolve the DWQ's comments. On June 2, 2006 the NCDOT responded that information regarding the Natural Channel Design for Mile Branch would be provided when available. Below are the comments made by DWQ in italics regarding the Natural Channel Design and the NCDOT's response.

**R-0609IA Stream Restoration Site – Natural Channel Design for Mile Branch**

- *The natural channel design indicates that current discharges were estimated using the NCDOT procedure for rural watersheds. Based on the Qualitative Indirect and Cumulative Effects Assessment for this project, the construction of this roadway corridor will lead to increased development of the watershed. Is it appropriate to utilize rural watershed discharges for a stream design that will be directly impacted by increased impervious area from the adjacent roadway as well as increased watershed development?*

The current natural channel design was completed prior to the development of stream discharge curves for urban watersheds. NCDOT has reviewed the Piedmont Urban Regional Curves published by NCSU's Stream Restoration Institute and believe these curves overestimate the

**MAILING ADDRESS:**
NC DEPARTMENT OF TRANSPORTATION
PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS
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FAX: 919-715-5501

WEBSITE: WWW.NCDOT.ORG

**LOCATION:**
2728 CAPITAL BLVD
SUITE 240
RALEIGH NC 27604

stream parameters thus giving a channel that is much wider and deeper than what is needed. The use of the rural curves is more appropriate. The ICE states that growth may occur in the Archdale area and along the I-85 corridor, which is south and east of the Mile Branch catchment. Also, development near the Mile Branch site will be limited because the entire catchment is in a Class IV water supply watershed.

- *Please provide predictive sediment transport computations for this natural channel design.*

Attached is a spreadsheet showing the calculated shear stress and the size of particle that needs to be moved. (See line 45)

- *The channel profile shows a straight channel bottom. Please provide a plan and profile that accurately depicts the designed streambed characteristics (pools, riffles, runs, glides, structures, etc). The contractor should have drawings that indicate every facet of the natural channel to ensure it is constructed in a manner that will remain stable.*

The profile has been revised to show channel features.

- *Please re-review the natural channel design. Based on the information provided, the Division is concerned with some of the design characteristics. In reviewing the provided information, it appears that the proposed Belt Width is greater than the Width of the Flood Prone Area. In addition, the sinuosity of the proposed channel appears to be too great, especially when compared to the reference reach. The addition of stormwater runoff in the future watershed creates concern that a very sinuous channel will be short circuited in heavy storm events despite the increased flood plain area. In reviewing the dimensionless ratios, the listed Ratio of Meander Length to Bankfull Width is shown as 12, and the ratio of Pool-to-Pool Spacing to Bankfull width is listed as 5. Since there are basically two pools per meander wavelength, one would expect the dimensionless Meander Length to Bankfull Width Ratio to be twice the dimensionless Pool-to-Pool Spacing Ratio. In addition, neither ratio corresponds to the ratios presented for the reference reach. While we can appreciate a desire to maximize stream length (and thus maximize stream credits), it is our belief that the stream as presented may have too flat of an average slope to adequately transport sediment. Please revise your designs to more accurately reflect the observed reference reach data by decreasing the sinuosity, and thereby increasing the effective slope of the stream. You may choose to provide an explanation for the present proposed design. Regardless, your submittal should include sediment transport computations to support the proposed design.*

The new design has reduced the sinuosity and the floodprone area is now greater than the belt width. During the design phase, the reference reach data is used in conjunction with stable characteristics of the existing channel to develop design parameters. In evaluating the existing stream, it was determined that the stream's profile and planview although incised, is fairly stable. It was determined to use this information along with bankfull indicators during the design. NCDOT believes the designed stream will be stable.

- *The Division's policy is that stream relocations be constructed "in the dry" and stabilized before water is turned into them. Please explain how the new channel will be constructed given its location is directly across the two tributaries that enter the channel in this location.*

The channel from approximately 10+40 to 11+40 can be constructed while the flow is maintained in the existing channel. The remaining portions of the channel will have to be constructed utilizing a pump around operation. By using the pump around operation, the flow will have to be turned back in the channel at the end of each workday. The pump around operation will be limited to the amount of channel that can be constructed within one working day. The channel will be seeded and mulched and coir fiber matting will be installed prior to water being turned into the channel at the end of each workday. Attached is a detail for the pump around operation.

- *The two small tributaries that will be entering the new channel join the main channel at sharp angles. This will increase stress on the far banks. Please provide computations or explanations that document the proposed tie in locations will not cause channel instability, or relocate the tie-ins.*

The tributaries have been adjusted to tie in at the outside bends. The location of the tie-ins will be at pools and will allow the energy to be dissipated in the pools.

- *Please provide a detailed streambank and buffer reforestation plan.*

A streambank and buffer reforestation plan has been included with this letter. The following components of Level 1 monitoring will be performed each year of the 5-year monitoring period: Reference photos, plant survival (i.e., identify specific problems areas (missing, stressed, damaged or dead plantings), estimated causes and proposed/required remedial action); visual inspection of channel stability. Physical measurements of channel stability/morphology will not be performed. A monitoring report will be submitted within sixty (60) days after completing the monitoring.

- *Please provide all modified and new information in English units.*

The impacts for all sites have been provided in English units.

Additional information on the project was also requested by DWQ for the subject project. In an email from Sue Homewood dated October 26, 2006, a request was made for a planting plan for both the R-2606A and R-0609IA stream restoration sites as well as the total square feet of buffer Zone 1 and buffer Zone 2 plantings. The planting plan needs to show the specific areas that will be planted on both sites. NCDOT has attached planting plans for both sites. Per the detail sheet for streambank reforestation, Type I planting includes live stakes and will be planted on the stream banks. Type II plantings are bareroot seedlings and will be planted in the hatched areas shown on the plan sheets.

In a phone call on November 13, 2006 with Sue Homewood, clarification was requested on the buffer mitigation at R-609IA Site 12 and the natural channel design on R-2606A. The NCDOT would like to withdraw Site 12 as an onsite buffer mitigation site because a permanent utility easement will require regular mowing of the site preventing the establishment of mature woody vegetation. The NCDOT also request that the DWQ allow buffer mitigation in the amount of 123,000 $ft^2$ (Zone 1-73,800$ft^2$, Zone 2- 49,200$ft^2$) on the recently submitted natural channel design located adjacent to R-2606A. Offsite buffer mitigation requirements currently total

5,494,663 $ft^2$. The EEP has previously committed to provide NCDOT with 5,589,011$ft^2$. The NCDOT will submit a revised request letter to EEP.

We believe that this letter satisfies all unresolved issues and hereby request the DWQ proceed with the processing of the application. If you have any questions or need additional information, please contact Brett Feulner at (919) 715-1488.

Sincerely,

E. L. Lusk

for Gregory J. Thorpe, Ph.D.
Environmental Management Director, PDEA

Mr. John Hennessy, NCDWQ
Mr. Gary Jordan, USFWS
Mr. Greg Perfetti, P.E., Structure Design
Mr. J.M. Mills, P.E., Div. 7 Engineer
Mr. Tim Johnson, P.E., Div. 8 Engineer
Mr. Mark Staley, Roadside Environmental
Mr. Jay Bennett, P.E., Roadway Design
Mr. Majed Alghandour, Programming and TIP
Mr. Richard Spencer, USACE
Mr. Travis Wilson, NCWRC
Mr. David Chang, P.E., Hydraulics
Mr. Jerry Parker, Div. 7 DEO
Mr. Art King, Div. 8 DEO
Mr. Scott McLendon, USACE, Wilmington
Mr. Art McMillan, PE, Highway Design
Mr. Mike Penney, PDEA

Project: **R-0609IA**
Location: **Site #6 Sta 32+20-L-R to 33+25 -L-R**
Design by: C. Heath Wadsworth, EI 12/1/2000
Checked by: Kevin Williams, PE 12/2/2000

**Natural Channel Design Methodology** (from Rosgen D-120)

32.) Step 1-17 Obtain Regional Curves for Bankfull Dimensions.
From **Rural** Regional Curve and using Drainage Area from Line 2,
Provide the following Regional Relations for Bankfull conditions:

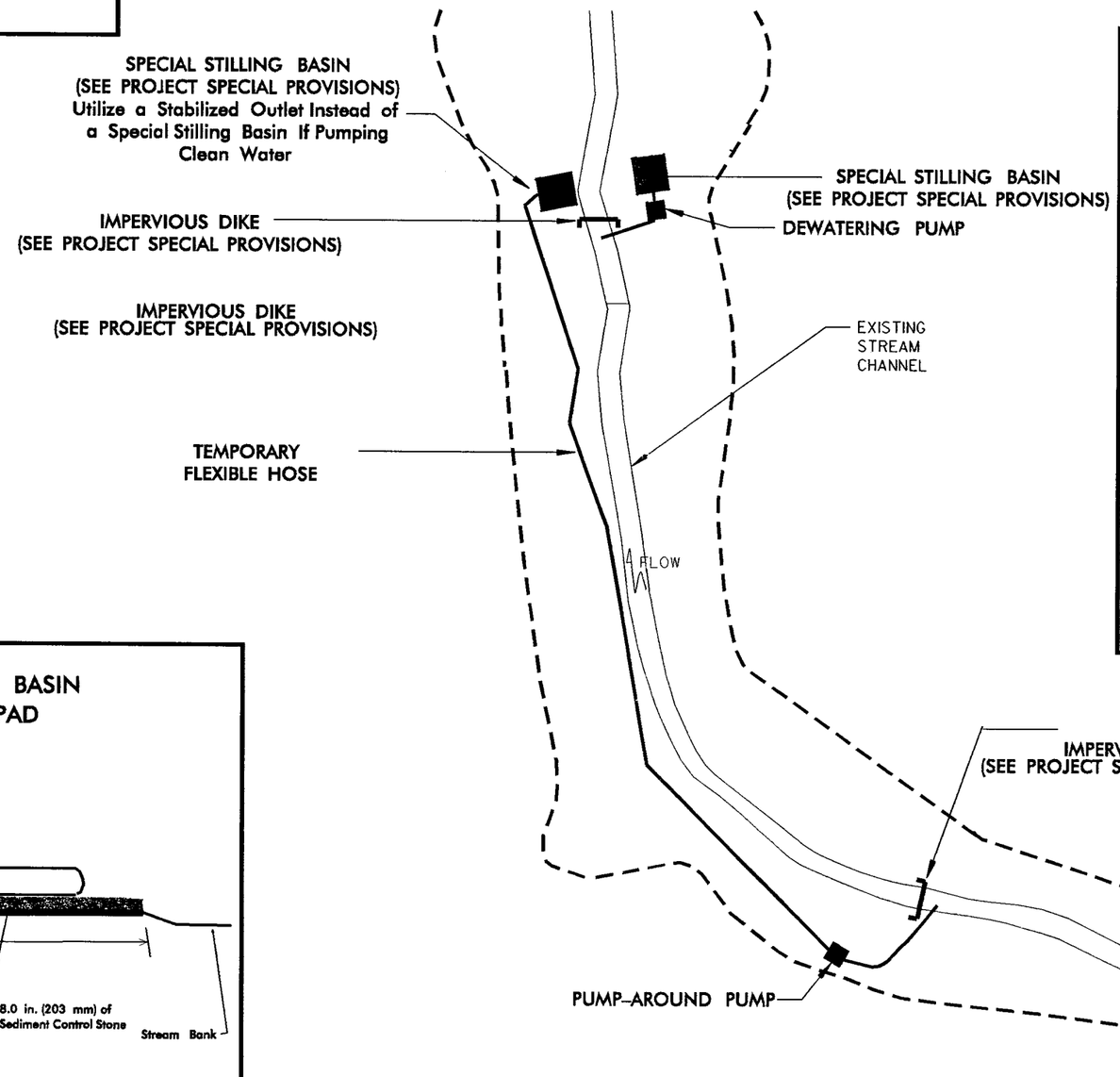
| | | | |
|---|---|---|---|
| | Bankfull Mean Depth = | 0.59 | m |
| | Bankfull Width = | 5.13 | m |
| | Bankfull Cross-Sectional Area = | 3.449 | $m^2$ |
| | Bankfull Discharge = | 6.100 | $m^3/s$ |
| 33.) Step 18 | **Type of Channel to Design** | **C4** | |
| | Allowable W/D ratio (from Stream Design Tables) | 12 | |
| | Acceptable Range = 12-18 | | |
| | **Proposed Bankfull Width $W_{bkf}$=** | **6.45** | **m** |
| 34.) Step 19 | Cross-Sectional from Regional Curve | 3.449 | |
| | **Proposed Bankfull Mean Depth $D_{bkf}$=** | **0.54** | **m** |
| 35.) Step 20 | **Mean Bankfull Velocity $V_{bkf}$=** | **1.8** | **mps** |
| 36.) Step 21 | $D_{max}/D_{bkf}$ Ratio (from Stream Reference Reach) | 1.48 | |
| | **Proposed Bankfull Max Depth $D_{max}$=** | **0.80** | **m** |
| 37.) Step 22 | **Proposed Flood Prone Width $W_{fpa}$=** | **45.00** | **m** |
| 38.) Step 23 | **Proposed Entrenchment Ratio** | **6.98** | |
| 39.) Step 24 | Lm ratio from reference reach data | 11.50 | |
| | Acceptable Range = 9-14 | | |
| | **Proposed Meander wavelength Lm=** | **75.0** | **m** |
| 40.) Step 25 | Rc ratio from reference reach data | 2.75 | |
| | Acceptable Range = 2.5-3.0 | | |
| | **Proposed Radius of Curvature** | **18.0** | **m** |
| 41.) Step 26 | Reference Reach Meander Width Ratio | 7.00 | |
| | Acceptable Range = 4-20 | | |
| | **Proposed Belt Width $W_{blt}$=** | **45.20** | **m** |
| 42.) Step 27 | Proposed Stream Length = | 201 | m |
| | Proposed Valley Distance = | 160 | m |
| | **Proposed Sinuosity** | **1.25625** | |
| 43.) Step 28 | Proposed Upstream Valley Elevation = | 217.62 | m |
| | Proposed Downstream Valley Elevation = | 216.9 | m |
| | Number of Structure Drops | 4 | |
| | Height of Drop | 0.13 m | |
| 44.) Step 29 | Riffle Slope ratio (from Stream Design Tables) | 1.50 | |
| | Acceptable Range = 1.5-2 | | |
| | **Proposed Slope S=** | **0.0024** | **m/m** |
| 45.) Step 30 | Hydraulic Radius = | 0.5158 | |
| | **Bankfull Shear Stress =** | **1.2390** | **kg/sq.m** |
| | What is range of Grain Diameter to be moved | 9 - 40 | mm |
| | From Field Data D50 Channel Material Size = | 16 | mm |

**Channel Dimensions are Good, Material will be Moved**

07/09/97

NOTES:
1) All excavation shall be performed in only dry or isolated sections of channel.
2) Impervious dikes are to be used to isolate work from stream flow when necessary.
3) All graded areas shall be stabilized within 24 hours.
4) Maintenance of stream flow operations shall be incidental to the work. This includes polyethylene sheeting, diversion pipes, pumps and hoses.
5) Pumps and hoses shall be of sufficicient size to dewater the work area.

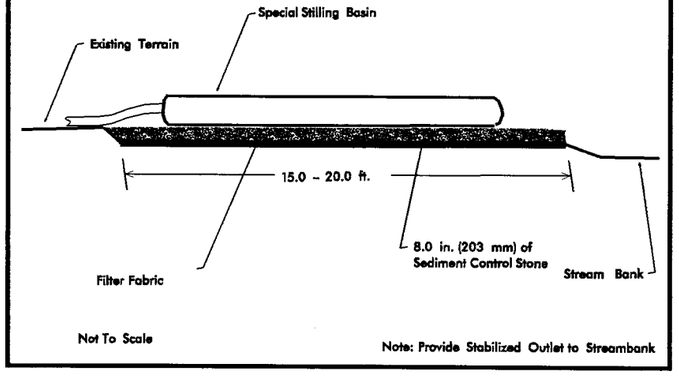
# EXAMPLE OF PUMP–AROUND OPERATION




SEQUENCE OF CONSTRUCTION FOR TYPICAL WORK AREA

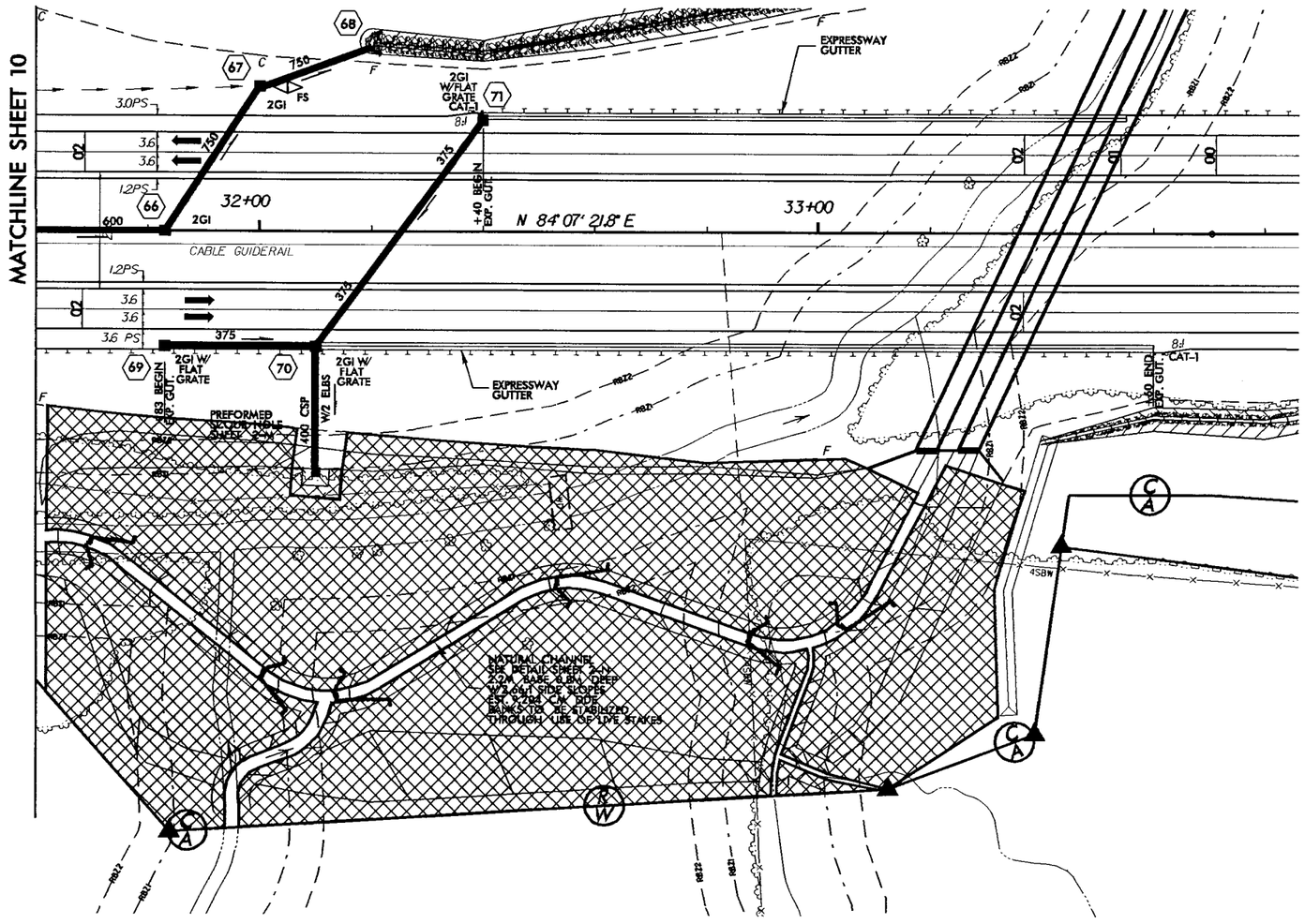
1. INSTALL SPECIAL STILLING BASIN(S)..
2. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
3. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS. DEWATER ENTRAPPED AREA. AREA TO BE DEWATERED SHALL BE EQUAL TO ONE DAY'S WORK.
5. PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLANS.
6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE. (DOWNSTREAM IMPERVIOUS DIKES FIRST).
7. ALL GRADING AND STABILIZATION MUST BE COMPLETED IN ONE DAY WITHIN THE PUMP AROUND AREAS BETWEEN THE IMPERVIOUS DIKES. THE IMPERVIOUS DIKE LOCATIONS AS SHOWN ON THIS SHEET ONLY SHOW THE UPPER AND LOWER EXTENT OF WORK FOR EACH STREAM SEGMENT. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE LOCATION OF THE IMPERVIOUS DIKE(S) FOR EACH DAY'S WORK.
8. REMOVE SPECIAL STILLING BASIN(S) AND BACKFILL. STABILIZE DISTURBED AREA WITH SEED AND MULCH.

## SPECIAL STILLING BASIN WITH ROCK PAD



| METRIC | PROJECT REFERENCE NO. | SHEET NO. |
|---|---|---|
| | R-0609IA | EC-50/CONST.II |
| | R/W SHEET NO. | |
| ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER | |

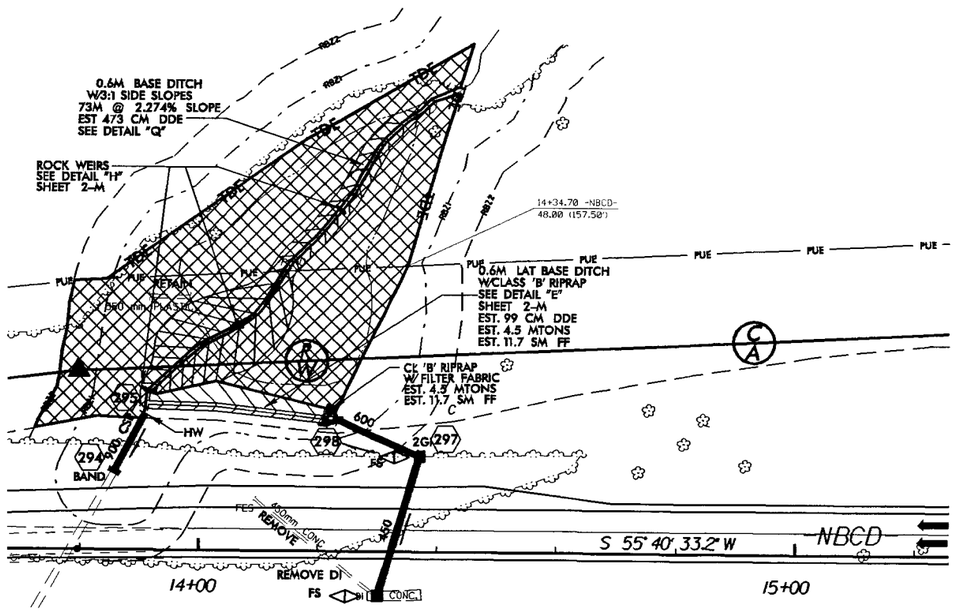
# 1.0 HECTARE STREAMBANK REFORESTATION




## SEE RF-2 AND PROJECT SPECIAL PROVISIONS

| METRIC | PROJECT REFERENCE NO. | SHEET NO. |
|---|---|---|
| | R-0609IA | EC-68A/CONST.29 |
| | R/W SHEET NO. | |
| | ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER |

# 0.2 HECTARE STREAMBANK REFORESTATION

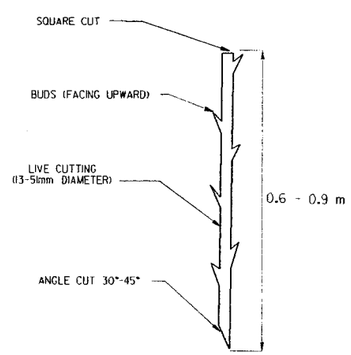


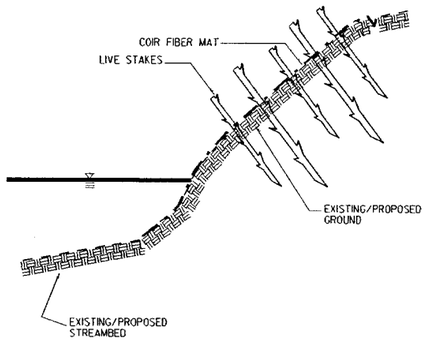

# SEE RF-2 AND PROJECT SPECIAL PROVISIONS

# PLANTING DETAILS

## LIVE STAKES PLANTING DETAIL

### LIVE STAKE

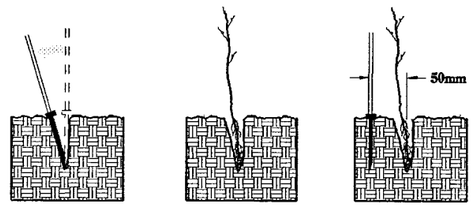


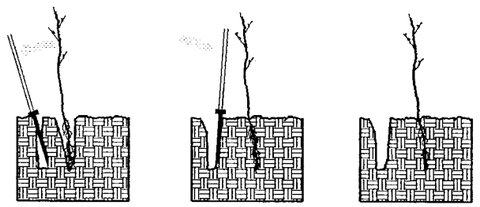

BANK STABILIZATION WITH LIVE STAKES

NOTE:
LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY 3/4 OF LIVE STAKE IS WITHIN GROUND

## BAREROOT PLANTING DETAIL
## DIBBLE PLANTING METHOD
## USING THE KBC PLANTING BAR




1. Insert planting bar as shown and pull handle toward planter.
2. Remove planting bar and place seedling at correct depth.
3. Insert planting bar 50mm toward planter from from seedling.



4. Pull handle of bar toward planter, firming soil at bottom.
5. Push handle forward firming soil at top.
6. Leave compaction hole open. Water thoroughly.

## PLANTING NOTES:

PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 300mm long, 100mm wide and 25mm thick at center.

ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 250mm below the root collar.

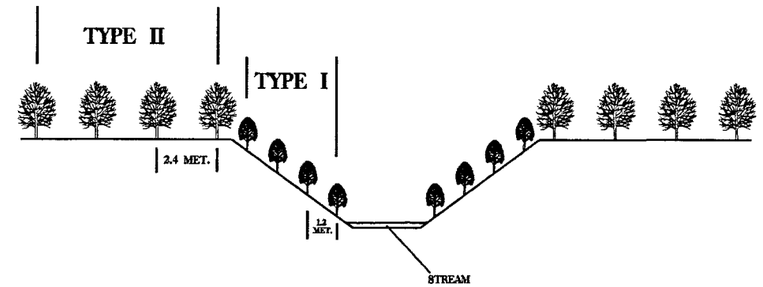
| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| R-0609IA | RF-2 |
| R/W SHEET NO. | |
| ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER |

☐ TYPE 1 STREAMBANK REFORESTATION SHALL BE PLANTED 0.9m TO 1.5m ON CENTER, RANDOM SPACING, AVERAGING 1.2m ON CENTER, APPROXIMATELY 6726 PLANTS PER HECTARE.

☐ TYPE 2 STREAMBANK REFORESTATION SHALL BE PLANTED 1.8m TO 3.0m ON CENTER, RANDOM SPACING, AVERAGING 2.4m ON CENTER, APPROXIMATELY 1680 PLANTS PER HECTARE.

☐ NOTE: TYPE 1 AND TYPE 2 STREAMBANK REFORESTATION SHALL BE PAID FOR AS "STREAMBANK REFORESTATION"

## STREAMBANK REFORESTATION TYPICAL




STREAMBANK REFORESTATION

MIXTURE, TYPE, SIZE, AND FURNISH SHALL CONFORM TO THE FOLLOWING:

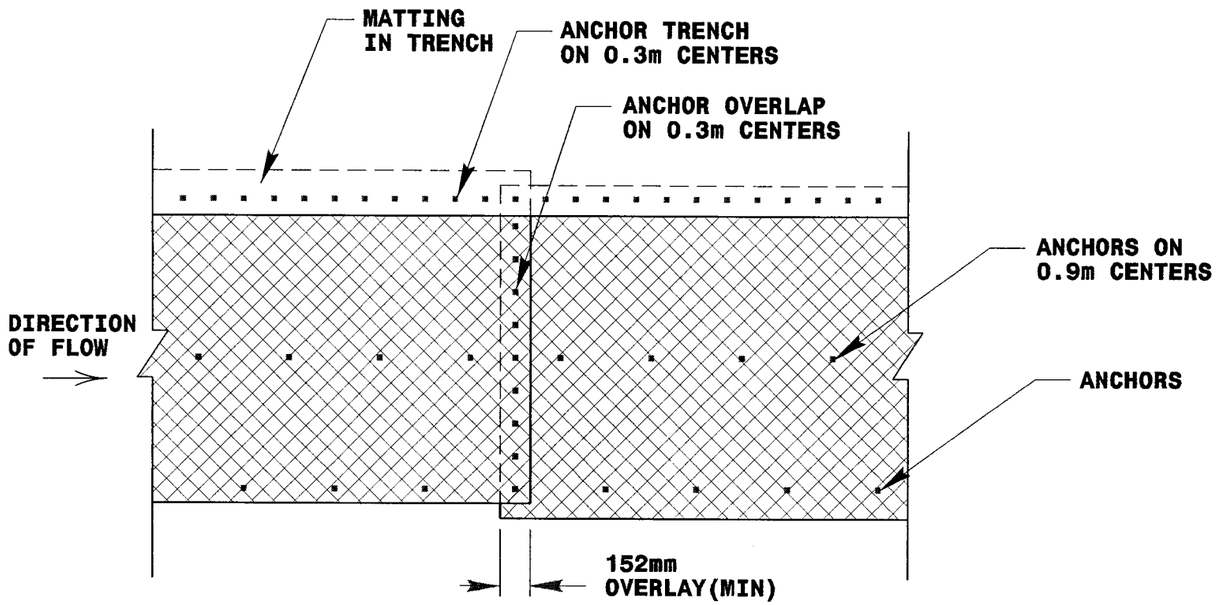
| | | | |
|---|---|---|---|
| TYPE 1 | | | |
| 50% | SALIX NIGRA | BLACK WILLOW | 0.6m to 0.9m LIVE STAKES |
| 50% | CORNUS AMOMUM | SILKY DOGWOOD | 0.6m to 0.9m LIVE STAKES |
| TYPE 2 | | | |
| 25% | LIRIODENDRON TULIPIFERA | TULIP POPLAR | 305mm - 457mm BR |
| 25% | PLATANUS OCCIDENTALIS | SYCAMORE | 305mm - 457mm BR |
| 25% | FRAXINUS PENNSYLVANICA | GREEN ASH | 305mm - 457mm BR |
| 25% | QUERCUS PHELLOS | WILLOW OAK | 305mm - 457mm BR |

☐ SEE PLAN SHEETS FOR AREAS TO BE PLANTED

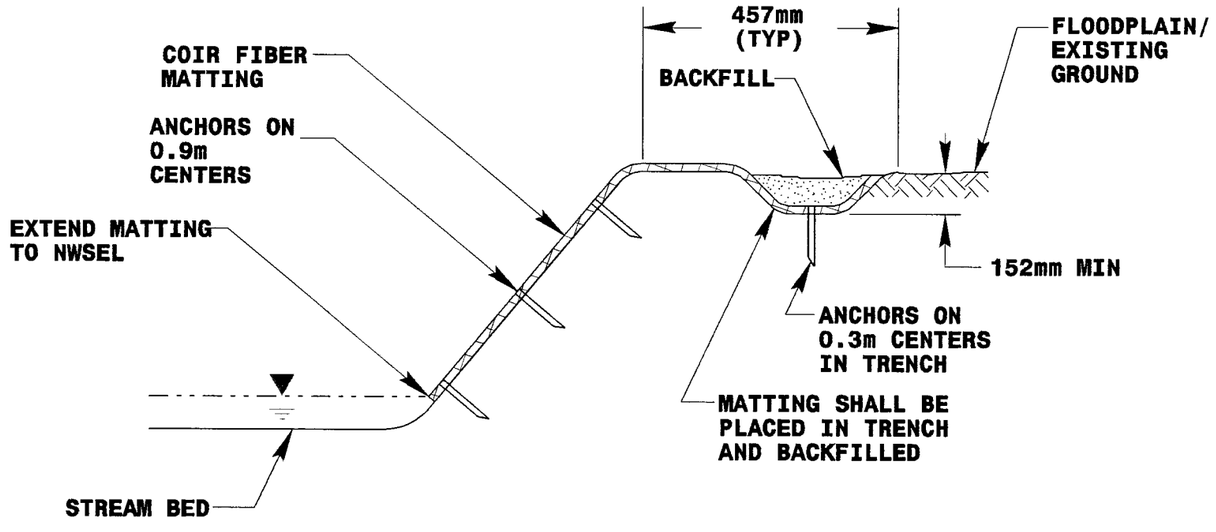
# STREAMBANK REFORESTATION
# DETAIL SHEET 1 OF 2

N.C.D.O.T. - ROADSIDE ENVIRONMENTAL UNIT

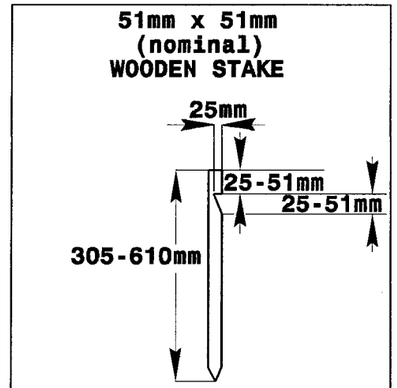
| METRIC | PROJECT REFERENCE NO. | SHEET NO. |
|---|---|---|
| | R-0609IA | RF-3 |
| | R/W SHEET NO. | |
| | ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER |

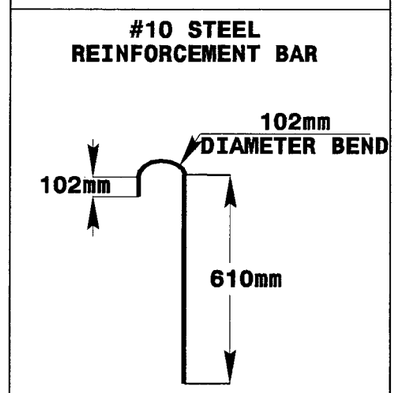


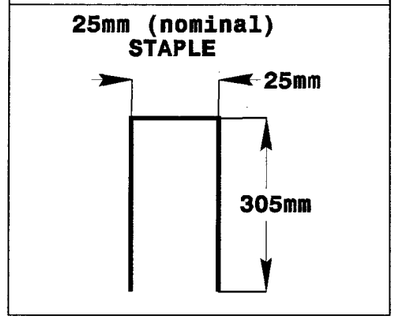

## PLAN VIEW




## TYPICAL CROSS SECTION




## ANCHOR OPTIONS

# COIR FIBER MATTING DETAIL

NOT TO SCALE

**STREAMBANK REFORESTATION**
**DETAIL SHEET 2 OF 2**
N.C.D.O.T.- ROADSIDE ENVIRONMENTAL UNIT

R-2606A Stream Length 1230 LF

30 Foot Buffer (Zone 1)

1230 x 30 x 2 = 73800SF

20 Foot Buffer (Zone 2)

1230 x 20 x 2= 49200 SF

Total = 12300 SF = 2.82 ac

Approximately 4.5 Acres will be replanted

# NORTH CAROLINA
# DEPARTMENT OF HIGHWAYS

| STATE | STATE PROJECT REFERENCE NO. | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|
| N.C. | R-2606 | L1 | 4 |

| STATE PROJ. NO. | F. A. PROJ. NO. | DESCRIPTION |
|---|---|---|
| | | |
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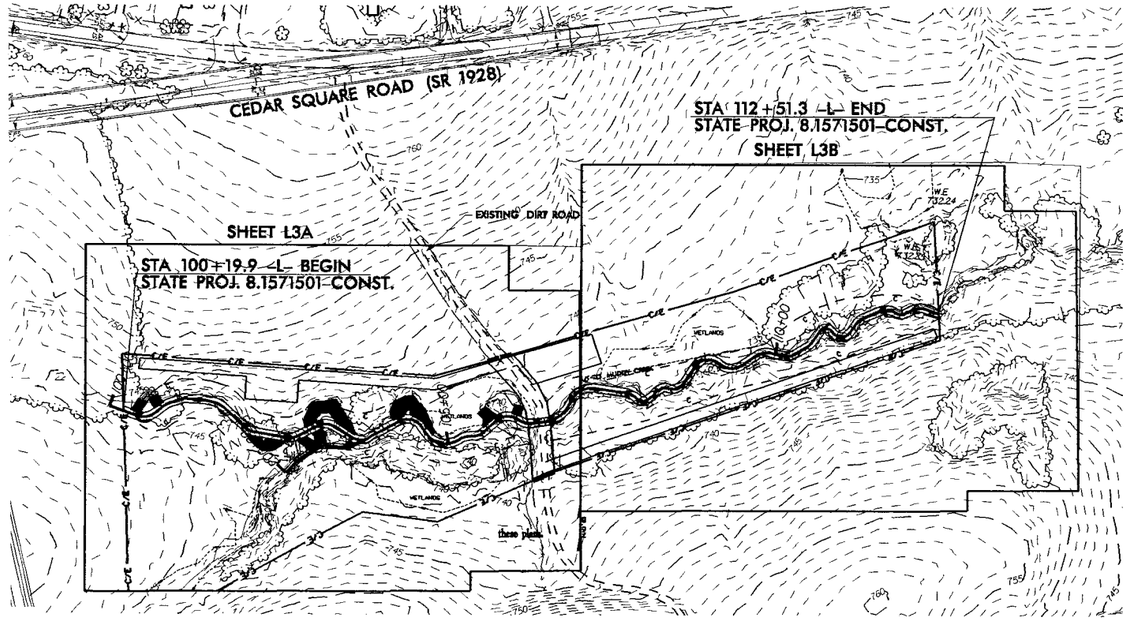
| | | |
| | | |
| | | |
| | | |

## RANDOLPH COUNTY
## PROPOSED PLANTING

***SITE CF-16: APPROXIMATELY 8 MILES SOUTHEAST OF HIGH POINT, ADJACENT TO THE PROPOSED US-311 BYPASS (R-2606). LOCATED ON THE NORTHEAST SIDE OF THE PROPOSED US-311 BYPASS, SOUTH OF CEDAR SQUARE ROAD (SR 1928) AND NORTH OF SPENCER ROAD (SR 1929).***

***STREAM AND FLOODPLAIN GRADING, IN-STREAM STRUCTURE PLACEMENTS, CULVERT INSTALLATION, AND ASSOCIATED EROSION AND SEDIMENT CONTROL MEASURES.***




**PRELIMINARY PLANS**
DO NOT USE FOR CONSTRUCTION

*PLANS PREPARED BY:*

Kimley-Horn and associates, Inc.


Kimley-Horn & Associates, Inc.
Post Office Box 33068
Raleigh, North Carolina 27636
(919) 677-2000

**Roadway Standard Drawings**

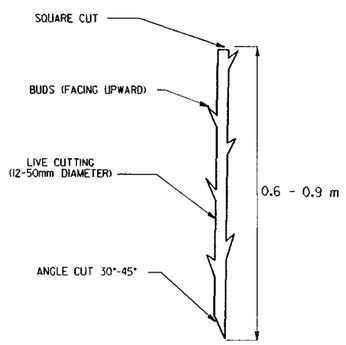
The following roadway english standards as appear in "Roadway Standard Drawings" - Roadway Design Unit - N. C. Department of Transportation - Raleigh, N. C., dated January 20, 2002 and the latest revison thereto are applicable to this project and by reference hereby are considered a part of

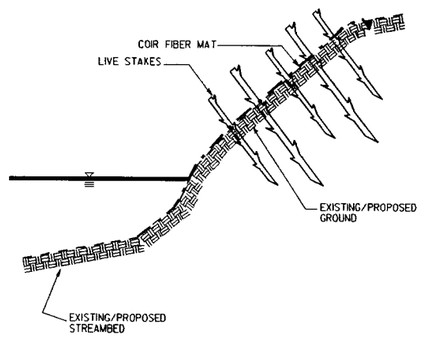
| | | | |
|---|---|---|---|
| 1605.01 | Temporary Silt Fence | 1632.01 | Rock Inlet Sediment Trap Type A |
| 1606.01 | Special Sediment Control Fence | 1632.03 | Rock Inlet Sediment Trap Type C |
| 1622.01 | Temporary Berms and Slope Drains | 1633.01 | Temporary Rock Silt Check Type A |
| 1630.01 | Riser Basin | 1633.02 | Temporary Rock Silt Check Type B |
| 1630.02 | Silt Basin Type B | 1634.01 | Temporary Rock Sediment Dam Type A |
| 1630.03 | Temporary Silt Ditch | 1634.02 | Temporary Rock Sediment Dam Type B |
| 1630.04 | Stilling Basin | 1635.01 | Rock Pipe Inlet Sediment Trap Type A |
| 1630.05 | Temporary Diversion | 1636.01 | Rock Silt Screen |

# PLANTING DETAILS

## LIVE STAKES PLANTING DETAIL

### LIVE STAKE

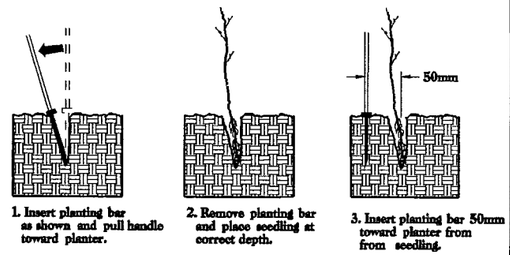


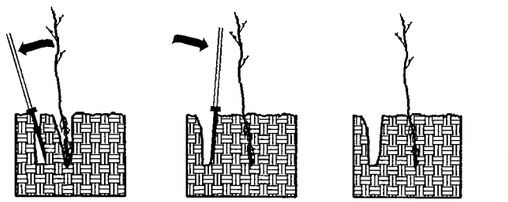

BANK STABILIZATION WITH LIVE STAKES

NOTE:
LIVE STAKES SHALL BE SPACED APPROXIMATELY 1.2 METERS ON CENTER
LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY ¾ OF LIVE STAKE IS WITHIN GROUND

## BAREROOT PLANTING DETAIL DIBBLE PLANTING METHOD USING THE KBC PLANTING BAR




1. Insert planting bar as shown and pull handle toward planter.
2. Remove planting bar and place seedling at correct depth.
3. Insert planting bar 50mm toward planter from from seedling.



4. Pull handle of bar toward planter, firming soil at bottom.
5. Push handle forward firming soil at top.
6. Leave compaction hole open. Water thoroughly.

## PLANTING NOTES:

PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 300mm long, 100mm wide and 25mm thick at center.

ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 250mm beluw the root collar.

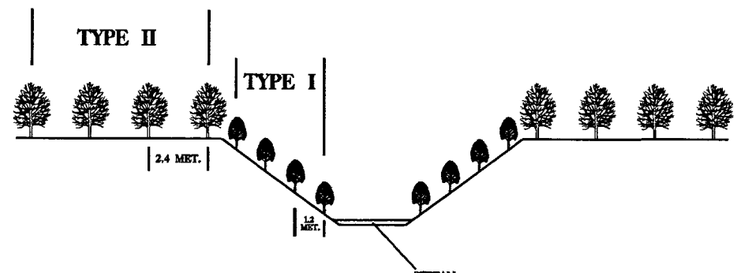
| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| R-2606 | L2 |
| R/W SHEET NO. | |
| ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER |

☐ TYPE 1 STREAMBANK REFORESTATION SHALL BE PLANTED 0.9m TO 1.5m ON CENTER, RANDOM SPACING, AVERAGING 1.2m ON CENTER, APPROXIMATELY 6726 PLANTS PER HECTARE.

☐ TYPE 2 STREAMBANK REFORESTATION SHALL BE PLANTED 1.8m TO 3.0m ON CENTER, RANDOM SPACING, AVERAGING 2.4m ON CENTER, APPROXIMATELY 1680 PLANTS PER HECTARE.

☐ NOTE: TYPE 1 AND TYPE 2 STREAMBANK REFORESTATION SHALL BE PAID FOR AS "STREAMBANK REFORESTATION"

## STREAMBANK REFORESTATION TYPICAL




STREAMBANK REFORESTATION

MIXTURE, TYPE, SIZE, AND FURNISH SHALL CONFORM TO THE FOLLOWING:

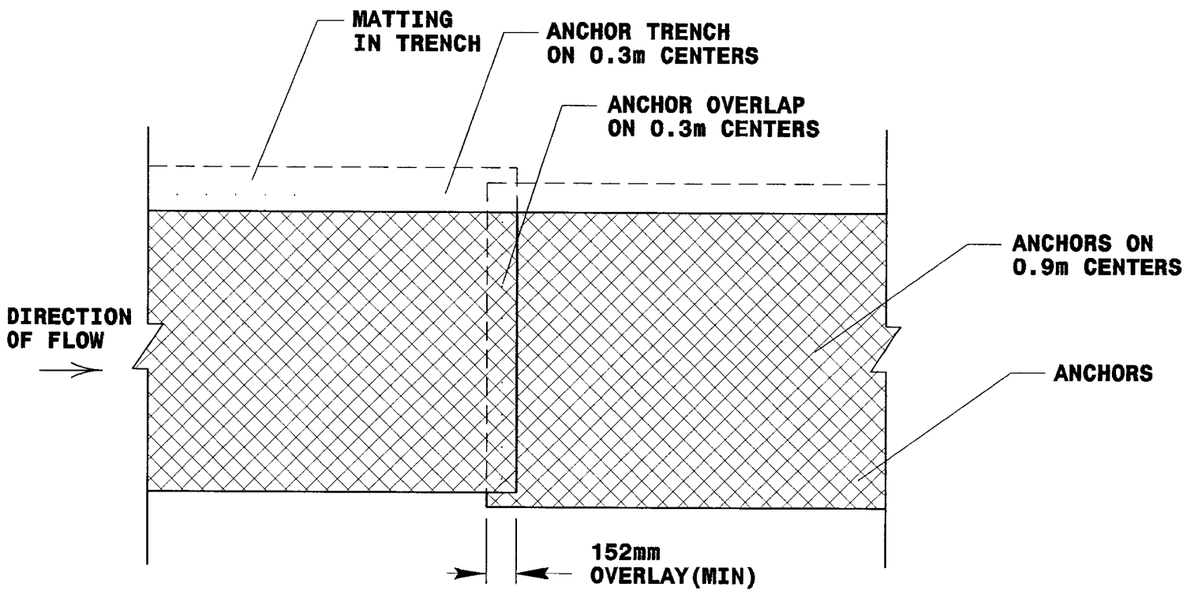
| | | | |
|---|---|---|---|
| TYPE 1 | | | |
| 50% | SALIX NIGRA | BLACK WILLOW | 0.6m to 0.9m LIVE STAKES |
| 50% | CORNUS AMOMUM | SILKY DOGWOOD | 0.6m to 0.9m LIVE STAKES |
| TYPE 2 | | | |
| 20% | LIRIODENDRON TULIPIFERA | TULIP POPLAR | 305mm - 457mm BR |
| 20% | PLATANUS OCCIDENTALIS | SYCAMORE | 305mm - 457mm BR |
| 20% | FRAXINUS PENNSYLVANICA | GREEN ASH | 305mm - 457mm BR |
| 20% | QUERCUS PHELLOS | WILLOW OAK | 305mm - 457mm BR |
| 20% | BETULA NIGRA | RIVER BIRCH | 305mm - 457mm BR |

☐ SEE PLAN SHEETS FOR AREAS TO BE PLANTED

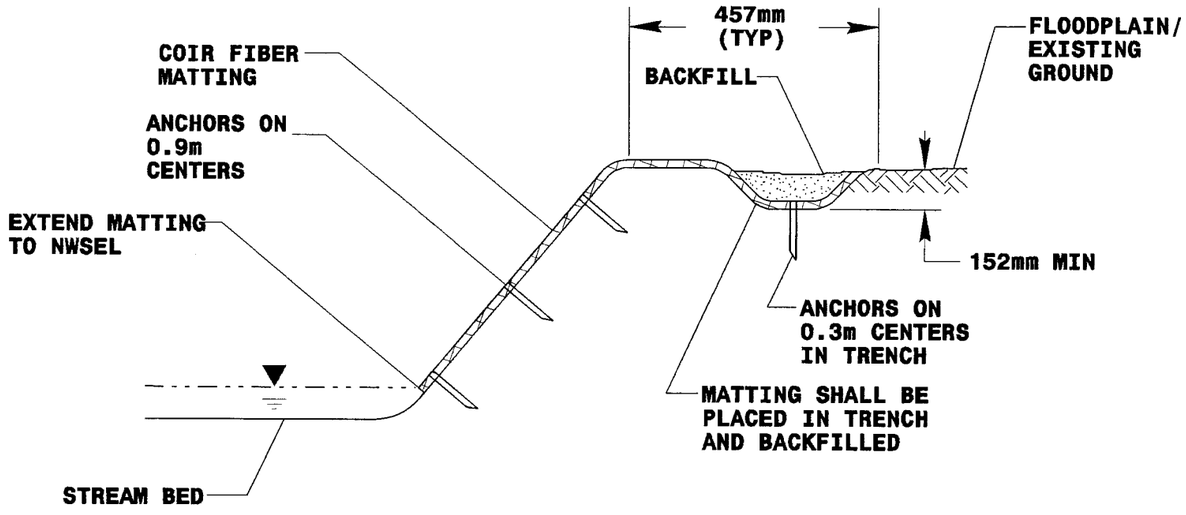
# STREAMBANK REFORESTATION DETAIL SHEET 1 OF 2

N.C.D.O.T. - ROADSIDE ENVIRONMENTAL UNIT

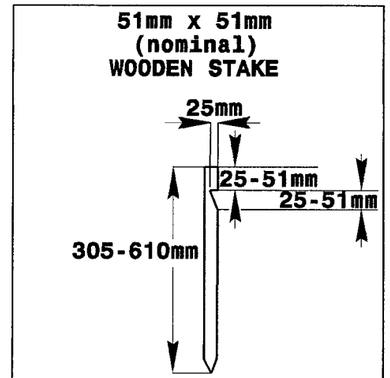
| METRIC | PROJECT REFERENCE NO. | SHEET NO. |
|---|---|---|
| | R-2606 | L2A |
| | R/W SHEET NO. | |
| | ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER |

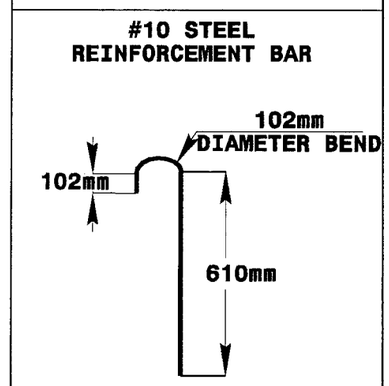


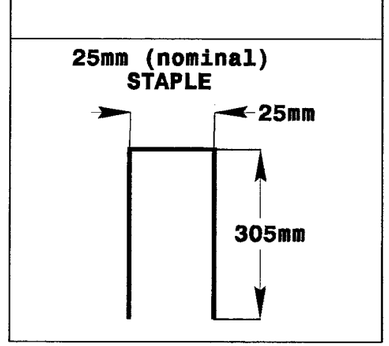

## PLAN VIEW




## TYPICAL CROSS SECTION




## ANCHOR OPTIONS

# COIR FIBER MATTING DETAIL

NOT TO SCALE

**STREAMBANK REFORESTATION**
**DETAIL SHEET 2 OF 2**
N.C.D.O.T.- ROADSIDE ENVIRONMENTAL UNIT

8-15-05

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| R-2606 | L3A |
| DESIGN ENGINEER | |

# PLANTING PLAN

4' PS

CK BL TAPER

755

750

745

740

EXISTING DIRT ROAD

STREAMBANK REFORESTATION ZONE

C/E

HAUL ROAD

100'00

EXISTING 36" CMP

WETLANDS

PROPOSED CONSERVATION EASEMENT

MATCH LINE STA 106+73 -L- SEE SHEET L3

NAD 83

LEGEND

RIPARIAN BUFFER ZONE

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )

8-15-05

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| R-2606 | L3B |
| DESIGN ENGINEER | |

# PLANTING PLAN

MATCH LINE STA 106+73 -L- SEE SHEET L2

PROPOSED CONSERVATION EASEMENT

STREAMBANK REFORESTATION AREA

HAUL ROAD

WETLANDS

W.E 732.24

735

740

745

750

755

760

C/E

3/3

NAD 83

## LEGEND

RIPARIAN BUFFER ZONE

GRAPHIC SCALE

30 0 15 30 60 120

( IN FEET )